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**Crew Behavior and Performance in Space Analog Environments:
A Mindfulness Analysis
FINAL REPORT**

According to Mindfulness Theory, an environment rich in sensory inputs but high in redundancy can be just as detrimental to performance as an environment impoverished in sensory inputs. This contrasts sharply with the standard view that increasing redundancy and differentiation of sensory inputs increases accuracy (e.g. Nagel, 1988; Sanders and McCormick, 1987; Wickens, 1987). According to Mindfulness Theory, redundant and differentiated environments, rather than improving accuracy, will produce a state of cognitive deprivation (analogous to sensory deprivation) that reduces accuracy. When nothing in the environment is perceived as novel or ambiguous, the sensory system will shut down.

An experiment was conducted to assess the relation between redundancy, differentiation, and accuracy. A monitoring task was developed in which subjects identified events representing potential collisions between aircraft. Three conditions were employed. In the control condition, subjects monitored 18 simulated aircraft whose position and altitude were updated every 3 seconds for 75 minutes. Target events consisted of simulated aircraft at the same altitude flying toward each other. To identify target events, subjects were required to monitor 72 relationships between simulated aircraft. With relationships updated every 3 seconds, 1440 relationships were presented each minute. Thirty-six 30-second target events occurred at a rate of one approximately every two minutes.

In the second condition, task redundancy was increased by requiring subjects to monitor continuously the proximity of aircraft to a target event. Subjects used keys ranging from 1 to 10 to indicate aircraft's proximity to a target event. All other requirements were identical to those in the control condition. Continuous monitoring of and response to non-target events decreases the proportion of responses occurring under target conditions which is believed to reduce the subjective frequency of the target events.

In the third condition, stimulus differentiation was decreased by creating two types of target events that were difficult to differentiate. Half the target events were identical to those in the control condition. The second half entailed simulated aircraft at the same altitude flying away from each other. This subtle differentiation between two types of events requiring distinct responses operationalizes the lack of differentiation standard

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theorist believe reduces accuracy. Mindfulness Theory predicts such subtle differentiation enhances cognitive activity and increases accuracy.

As predicted by mindfulness theory, increased redundancy reduced accuracy while decreased differentiation increased accuracy. The task was sufficiently difficult that subjects in the control condition failed to identify or falsely identified target events as frequently they correctly identified these events. Increased task redundancy substantially reduced accuracy while decreased differentiation increased accuracy. This pattern, depicted in Figure 1, was statistically significant $F(2, 38)=9.20$, $p. < .01$.

These results suggest that standard approaches to increasing accuracy through greater task redundancy and greater stimulus differentiation are misguided¹. Developing tasks to be less redundant and require more subtle differentiation would increase the perceived novelty and ambiguity of the environment and, in turn, induce a more mindful state.

¹A more complete analysis of these result are available in Brown (1991).

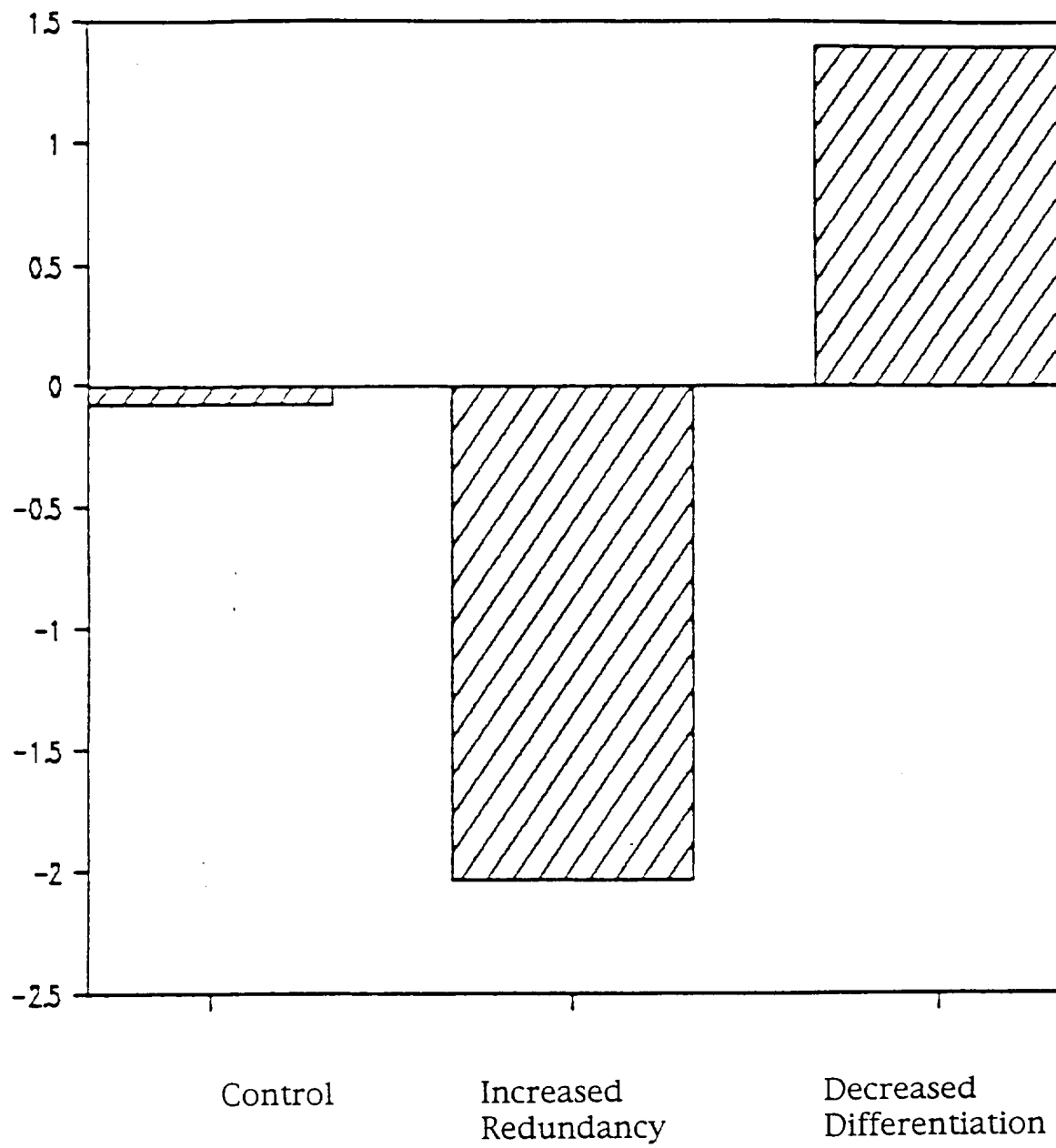


FIGURE 1: ACCURACY

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A handwritten signature in black ink, appearing to be 'E. J. McCormick', located at the bottom left of the page.